PATENT SPECIFICATION

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(54) HIGH FREQUENCY ELECTRONIC EPILATION MEANS

(71) We, SLIMMASTER BEAUTY EQUIPMENT (SALES) LIMITED, a British Company, Regent House, Dock Road, Birkenhead, Merseyside, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to improved methods and apparatus for epilation particularly useful in the removal of superfluous human hair.

According to the invention there is provided a method of epilation in which radio frequency energy is applied to each hair to be removed at a point between its ends so as to flow toward the root of the hair to cauterise such root and permit ready withdrawal of the hair from its follicle, the energy being supplied from a radio frequency generator by way of a resonant radio frequency transmission line of such a length as to optimise the transfer of said energy from the generator to the hair. Conveniently the means used to apply the energy to the hair serves also to grip the hair for the purpose of withdrawal. Such means may be in the form of tweezers of which the main body part is electrically insulated and at least one of the two jaw parts is of metal and is connected by a coaxial cable to the output of the radio frequency generator.

Also according to the invention there is provided apparatus for the epilation comprising a radio frequency generator connected to supply radio frequency energy to at least one of a pair of jaws of a tweezer device by means of which jaws a hair to be removed can be gripped and such energy applied to it to cauterise its root, the radio frequency generator being connected to the tweezer device by way of a radio frequency transmission line of such a length as to optimise, when resonant, the transfer of said energy from the generator to the hair.

The various features and advantages of the invention will be apparent from the following description of a preferred embodiment taken in conjunction with the accompanying drawings, of which:—

Figures 1, 2 and 3 are respectively plan, side elevation and end elevation views of a tweezer device for carrying out the method of the invention and,

Figure 4 is a circuit diagram of a preferred form of radio frequency generator for energising the device of Figures 1-3.

Referring to Figures 1-3 the tweezer device comprises a main body part 1 of bifurcated form made wholly from, or coated with, a suitable electrically insulating material. In the free end of each limb of the body part 1 is embedded one end of a jaw member 2 at least one of which is of metal and is connected to the centre conductor 3a of a coaxial cable 3, which acts as a radio frequency transmission line. The cable 3 extends longitudinally of one of the limbs of the body part 1 to emerge at the end of the tweezer device remote from the jaws 2 and extends to the coaxial output terminal Z of a radio frequency generator indicated by the block RFG in Figure 1. The limb of body part 1 through which the cable 3 extends carries on its inner face a tongue 4 which extends into a slot 5 in the other limb of body part 1 so that the jaws 2 remain aligned in the same general plane as the limbs are pressed towards each other by an operator in gripping a hair.

For efficient operation of the method the hair should be gripped at a point close to but spaced from the skin and the level of radio frequency energy applied to the hair should correspond to a power input to the r.f. generator in the range 30-50 watts. Such applied energy level and spacing will both influence the speed at which the hair root

is cauterised and thus the speed at which treatment can proceed. The preferred frequency of the energy is in the range 25 to 30 Mhz a typical operating frequency being 27.1 Mhz. The length of the coaxial cable is chosen to be such that the load impedance presented by the cable and tweezer device to the generator can readily be matched by adjustment of a matching network at the output of the generator, for the optimum transfer of energy to the hair being gripped by the tweezer device i.e. to maximise the line impedance at the tweezer end and minimise its impedance at its other end at resonance as is the case with a line that has an effective length equal to an old multiple of quarter wavelengths. Any conventional configuration of radio frequency generator pretuned or tunable to the desired frequency and capable of delivering the necessary power when matched to the tweezer device will suffice to energise the tweezer device but a preferred form of such generator will now be described with reference to Figure 4.

The generator of Figure 4 comprises two thermionic valves V1 and V2 arranged to function respectively as a crystal controlled Colpitts type master oscillator and as a power amplifier, a tunable network being provided to deliver the generator output to the coaxial output terminal Z of the apparatus.

A crystal X in a Colpitts type oscillator circuit formed by capacitors C1, C2 resistor R1 and coil RFC1, is oscillated by feedback through capacitors C1 and C2 and provides the drive for valve V1, coil RFC1 allowing the cathode of the valve to assume the required r.f. voltages. An inductor L1 and capacitors C3 and VC1 form a tuned anode circuit of the valve V1, VC1 being adjustable to select the required oscillator output frequency of 27.1 Mhz. Resistor R2 provides the high tension voltage to the screen grid of valve V1 and resistor R3, with capacitors C4, C5 and C7 providing the appropriate valve decoupling.

The output of valve V1 is taken from the junction of capacitors C3 and VC1 and is fed to the grid of valve V2. Grid current flowing through resistor R10 (connected between terminals AA) and resistor R4 provides the grid bias voltage for the valve V2.

The resistor network R7, VR1 and R8, decoupled by capacitor C10 provides a potentiometer by means of which the output of valve V2 may be increased or reduced, thus providing an output "strength" or "intensity" control for use by the operator.

A footswitch FS1 connects the cathode circuits of the valves V1 and V2 to ground so that when the switch is open neither valve is operative, and a resistor R5 connected between the cathode of valve V2 and ground prevents the cathode assuming a dangerously high voltage when the footswitch is open.

Resistor R6 and coil RFC3 connected to the anode of valve V2 prevent parasitic oscillaions in the anode circuit of valve V2, and choke RFC4 prevents radio frequencies reaching the power supply.

The power amplifier valve V2 is rated for an anode dissipation of 20 watts and is capable of providing up to 43 watts output power into a non-inductive load of about 80 ohms.

The tunable impedance matching network formed by capacitor VC2, inductor L2 and capacitor VC3 is adjusted to match the output impedance of valve V2 to the co-axial line which when resonant at the operating frequency has a low impedance at the socket Z and a high impedance at the tweezer termination. This circuit is also advantageous in eliminating unwanted harmonics from the output. Coil RFC5 prevents the output socket Z, and hence the cable 3, attaining a dangerously high voltage should a failure of capacitor C11 occur.

To set up the generaor the following procedure may be adopted. The coaxial cable 3 with tweezers attached is connected to socket Z. With the minimum setting of resistor VR1, the footswitch closed and switch SW2 set to position AA in which a milliammeter M/A is connected across resistor R10 to measure the grid current of valve V2. Capacitor VC1 is tuned for a peak in the grid current to V2, i.e. about 2MA. Then the output circuit of valve V2, capacitor VC2 and inductor L2 must be tuned with the load to resonance. The switch SW2 is then set to position BB, connecting the milliammeter M/A across resistor R9 to measure the anode current of valve V2.

With the footswitch FS1 closed, the capacitor VC3 set to maximum capacity resistor VR1 is now increased to half value, the capacitor VC2 is adjusted until a dip in the meter reading indicates resonance.

The capacitor VC3 is now adjusted to cause an increase in the meter reading and the capacitor VC2 is returned resonance. Each step is repeated until an optimum is reached at, say, half full scale deflection of the meter.

Potentiometer VR1 is then set to maximum and the above steps are again repeated until the output current increases to approximately threequarters of full scale deflection when satisfactory tuning of the output of the valve and load is complete and optimum power is available to the load i.e. co-axial cable 3 and tweezers 1.

A small lamp P/L is driven by a coil L3 of one turn which is inductively coupled to coil L2. When coil L2 is resonant a small r.f. current flows in the circuit L3-P/L causing the lamp to glow brightly and provide an indicaion that maximum output power is

available for the tweezers.

It will be noted that because the cathodes of valve V1 and V2 are normally disconnected and it is necessary to press the foot switch to carry out the above setting up procedure and—once set up—for the operator to get any output power at all, complete safety is assured whilst the equipment is quiescent.

Power supplies are obtained via an isolating mains transformer T1 having a primary winding P1, centre tapped secondary winding S1 and heater winding H1. An h.t. voltage of 500 v.D.C. for valve V2 is provided on line 10 connected to the positive output terminal of a bridge rectifier REC1 which is connected across the secondary winding S1.

An ht. voltage of 250 v.D.C. for valve V1 is provided on line 12 which is connected to the centre tapping. The voltages on lines 12 and 10 are smoothed and decoupled by capacitors C13 and C14 respectively.

Radio frequency chokes RFC6 and RFC7 are connected in series with the primary winding P1 and respective switch contacts SW3 and SW4, to which is connected an a.c. supply by way of fuse F1. The chokes RFC6 and RFC7 serve to isolate radio frequencies from the supply. Additional positions CC and DD of switch SW2 enable the milliammeter to be connected in series with resistors R11 and R12 to measure the h.t. voltages at corresponding points C′ and D′ of lines 12 and 10 respectively.

Once set up the operator is only required to switch on and let the equipment warm up for about one minute. With the footswitch depressed the operator then sets the intensity control to the pretuned maximum —the switch SWS being left in position BB —and the equipment is ready for use.

With the equipment ready for use—the output pre-set and footswitch off—the operator carefully and firmly holds each hair to be removed in the tweezers as near as possible to the skin without touching. The hair is kept under gentle tension and the footswitch pressed. The R.F. currents from the equipment, transmitted via the connecting cable, to the tweezers will cauterise the hair root in 2-10 seconds and the hair will pull out without any pain or damage.

Preferably the equipment is so arranged that it is not readily possible for an unskilled person to tamper with the tuning mechanism. To this end the equipment preferably is enclosed in a housing or cabinet designed to include a tuning panel which enables a skilled person to make any critical adjustments without the need for opening the housing or cabinet.

WHAT WE CLAIM IS:—

1. A method of epilation in which radio frequency energy is applied to each hair to be removed, at a point between its ends so as to flow toward the root of the hair to cauterise such root and permit ready withdrawal of the hair from its follicle, the energy being supplied from a radio frequency transmission line of such a length as to optimise the transfer of said energy from the generator to the hair.

2. The method as claimed in claim 1 in which a hair to be treated is gripped at a point between its ends by the jaws of a tweezer device to at least one of which jaws radio frequency energy is supplied from the generator and upon cauterisation being effected the hair is withdrawn by the tweezers device.

3. The method as claimed in claim 1 or 2 utilizing radio frequency energy at a frequency in the range 25-30 Mhz.

4. Apparatus for carrying out the method claimed in claim 1 comprising a radio frequency generator connected to supply radio frequency energy to at least one of a pair of jaws of a tweezer device by means of which jaws a hair to be removed can be gripped and such energy applied to it to cauterise its root, the radio frequency generator being connected to the tweezer device by way of a radio frequency transmission line of such a length as to optimise, when resonant, the transfer of said energy from the radio frequency generator to the hair.

5. Apparatus as claimed in claim 4, wherein the radio frequency transmission line is connected to the radio frequency generator by an adjustable impedance matching network.

6. Apparatus as claimed in claim 4 or 5, wherein the radio frequency transmission line is a coaxial cable.

7. Apparatus as claimed in claim 4 or 5 or 6 wherein the tweezer device comprises a main body part of bifurcated form which electrically insulates the jaw or jaws to which the energy is supplied.

8. Apparatus as claimed in claim 7 wherein the co-axial cable extends longitudinally of one limb of the body part of said tweezer device.

9. Epilation apparatus substantially as herein described with reference to Figures 1-3 or Figures 1-4 of the accompanying drawings.

10. A method of epilation substantially as herein described with reference to Figures 1-3 or Figures 1-4 of the accompanying drawings.

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1 513 057
2 SHEETS

COMPLETE SPECIFICATION

This drawing is a reproduction of the Original on a reduced scale

SHEET 1

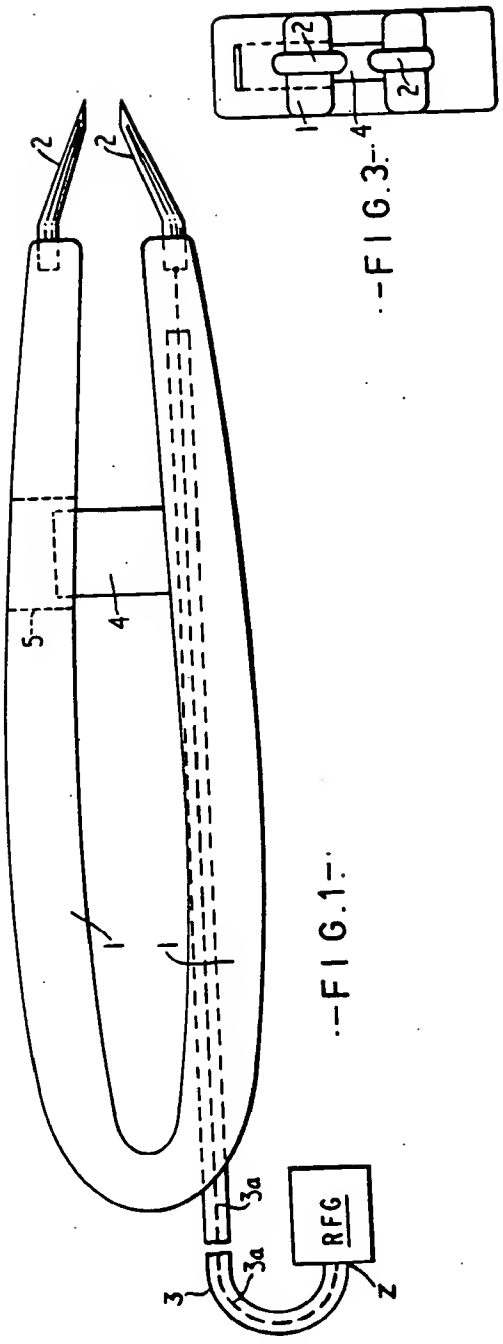

FIG.1.

FIG.3.

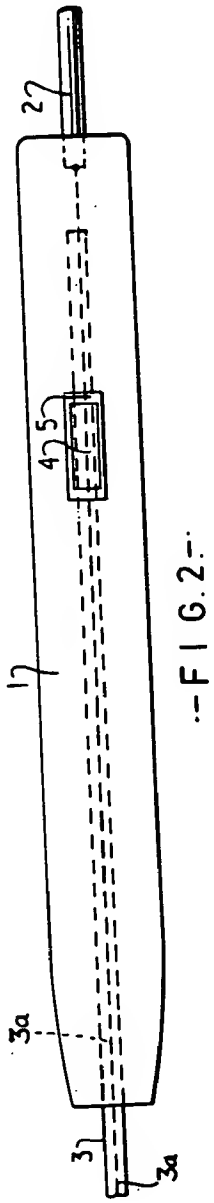

FIG.2.

1 513 057
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COMPLETE SPECIFICATION

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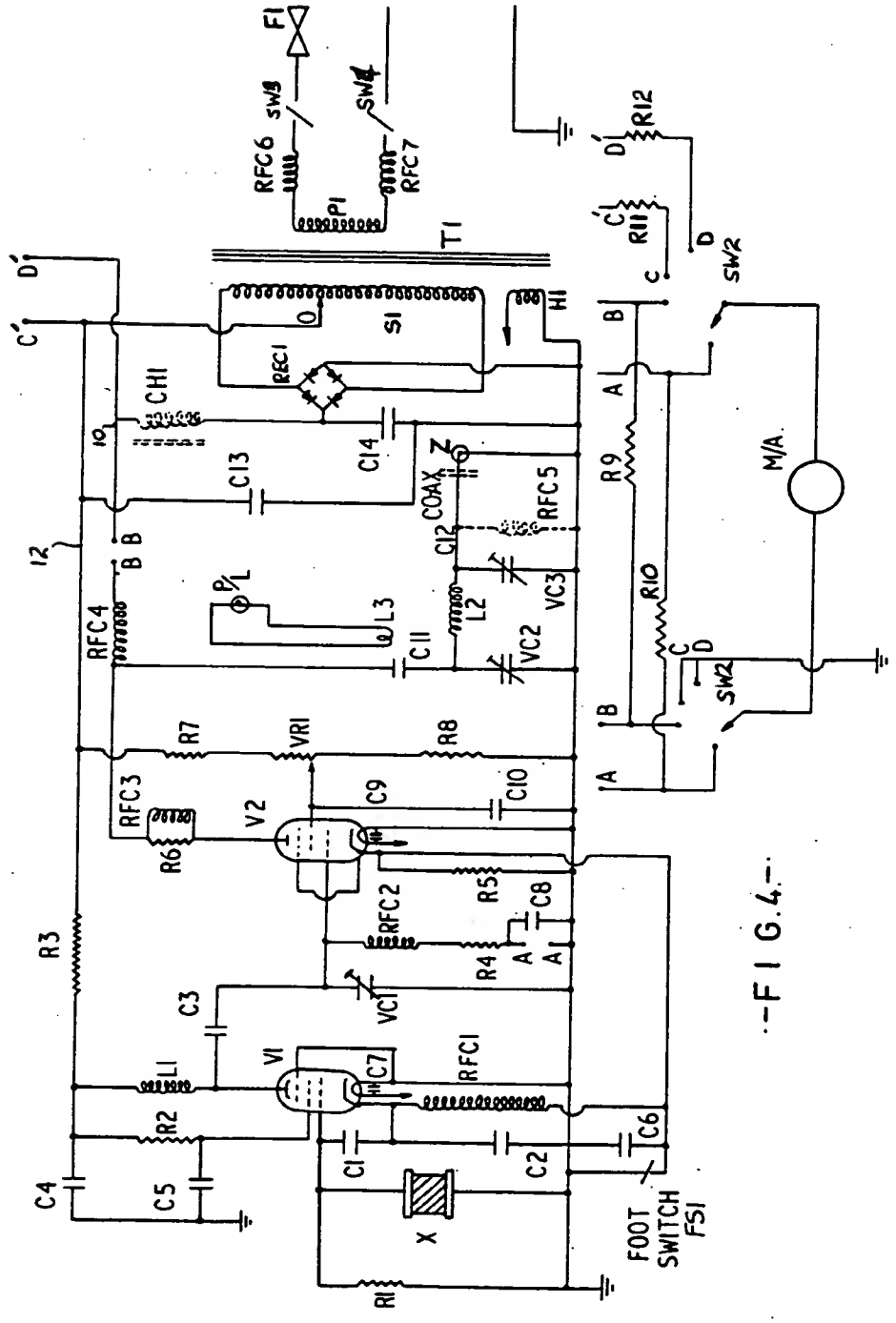
SHEET 2



-FIG.4-